Research, Development & Engineering Command

Aviation and Missile Research, Development and Engineering Center (AMRDEC)

"MISSILE RECYCLING CAPABILITY (MRC) OVERVIEW"

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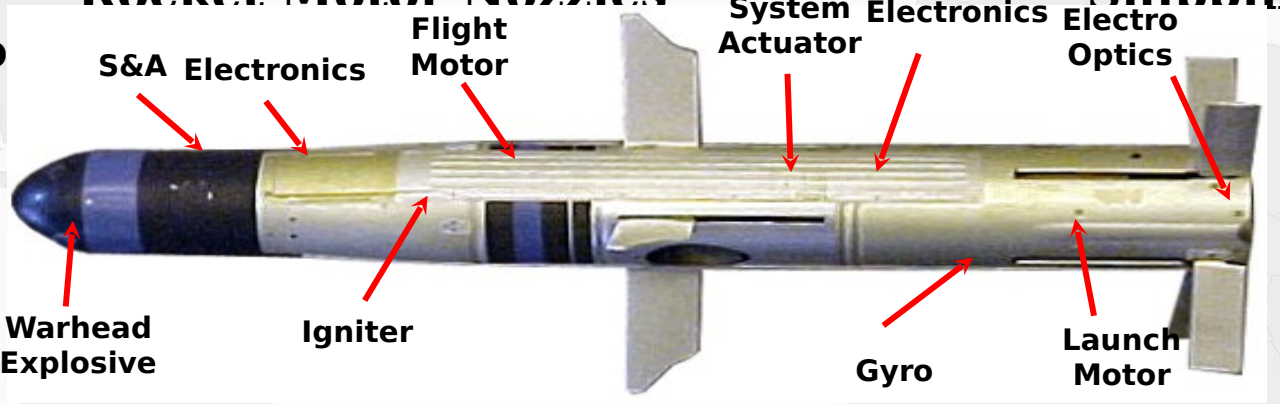
2007 Global Demilitarization Symposium & Exhibition
14-17 May 2007

ACKNOWLEDGEMENTS

What is a Missile Recycling Capability?

- >98% of TOW missile components are recyclable
  - Missile Warheads
  - Rocket Motor Propellants
  - Rocket Motor Cases
  - Rocket Motor Nozzles
  - Launch Tubes
  - Guidance & Control Components
  - Airframe Components
  - Shipping Co

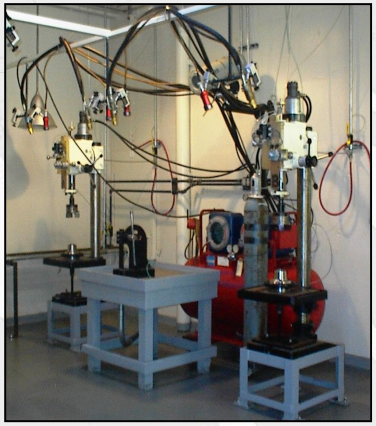


- **Major MRC Modules**
  - Missile Disassembly
  - Rocket Motor Denozzling
  - Propellant Removal
  - Warhead Explosive Removal
  - Energetics Processing
  - Slurry Explosive Manufacturing
  - Hardware Decontamination
  - Material Handling &

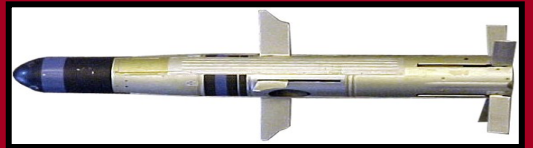
ADMC Missile Recycling Center

Missile Disassembly Operations

Warhead Billet Press-out Machines

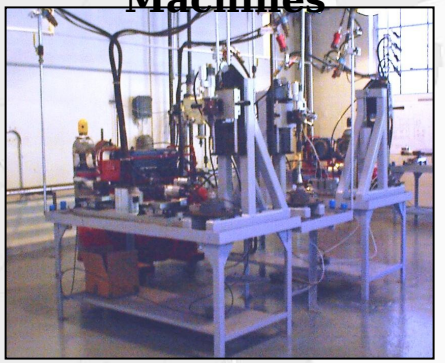


Launch Motor Denozzling Machines



TOW Missile System Recycling

Warhead Billet Splitting Machines



Flight Motor Denozzling Machines

- Resource Recovery and Recycling (R^3) Minimizes Air, Ground, & Water Contamination
- Recycling Provides Low Cost Components for New Missile Builds

AMRDEC Technology Transition to Production at the ADMC

Removal of Missile from Launch Tube

Removal of Flight Motor from Missile

ADMC MRC Production Facility

- Processed 5,085 TOW missiles during FY03 LRIP
- Processed 9,640 TOW missiles during FY04
- Processed 14,944 missiles during CY05
- Processed 13,408 missiles during CY06

TOW Flight Motor Denozzling Machine

Warhead Billet Removal Machine

MRC Propellant Removal Modules

Vertical Milling Machine

Typical Propellant Chips

- Removes <99% of the propellant from the rocket motor case
- Scheduled to install four TOW milling machines at the ADMC in 3rd
  - QTR FY07

ADMC MRC Component Reuse

Launch Tube Reuse

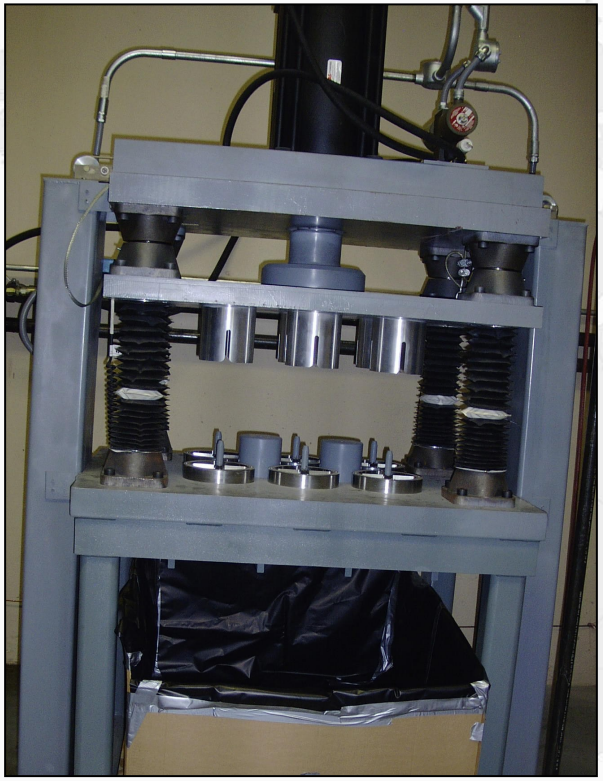
Additional Launch Tube Parts for Reus

Forward Fixed Coupling
Flex and Retainer Seal
Aft Fixed Coupling
Forward Quick Release

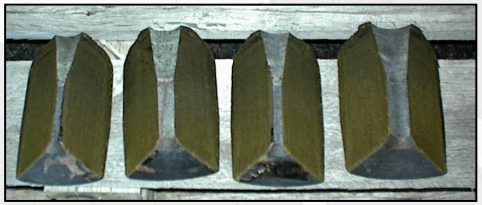
- **Source of Supply for FMS & New Army Missile Builds**
  - **2,858 launch tubes shipped to Raytheon, Inc. in FY 03-05**
  - **~ 5,000 tubes and additional parts currently being reused for FY 06-07**
  - **Wire bobbins are now being recovered**
- **Source of Supply for Operation Iraqi Freedom**
  - **3,024 missile boxes & missile packing inserts**
  - **1,700 forward end covers and extension rings**

MRC Energetics Size Reduction Module

TOW Flight Motor Grain Before Splitting



TOW Grain Splitter (6 grains/cycle)



TOW Flight Motor Grain After Splitting

- Splits TOW flight motor grains into quarters prior to size reduction

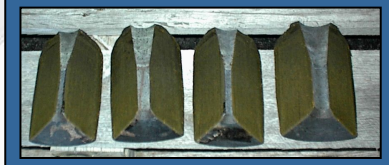
MRC Energetics Size Reduction Module

Launch Motor Propellant Shear Machine (24 sticks/batch)

- **Removes aluminum suspension pin from end of launch motor propellant stick prior to size reduction**

MRC Energetics Size Reduction Module

LX-14 Before Size Reduction



TOW Rocket Motor Grains Before Size Reduction

Energetics Size Reduction Machine for the ADMC

LX-14 After Size Reduction

TOW Rocket Motor & Igniter Grains After Size Reduction

- Reduces the size of recovered bulk energetic materials
- SRM equipment and controls installed
- Upgraded hydraulic system installed
- Scheduled to begin operations in 3rd QTR FY07

MRC Slurry Explosive Module (SEM)

Building 65, Designated SEM Site at the ADMC

Slurry Mixer

Mining Explosive Product

- Incorporates ~25% low value energetic material into a commercial slurry explosive
- All components and tanks installed at the ADMC
- System Integration and Check-out (SICO) completed 3rd QTR FY07

MRC Slurry Explosive Module (SEM)

Ammonium Nitrate Storage Bin and Hammer Mill

Portable Propellant Bin

Propellant Unpack Bay

Main Processing Bay

MRC Slurry Explosive Module (SEM)

Mother Solution Storage Tanks

Wet Scrubber System

MRC Slurry Explosive Module (SEM)

Slurry Mixer

MRC Slurry Explosive Module (SEM)

Product Bagging Area with Conveyor

Automated Printer Control Pa

MRC Slurry Explosive Module (SEM)

Electrical Control Panel

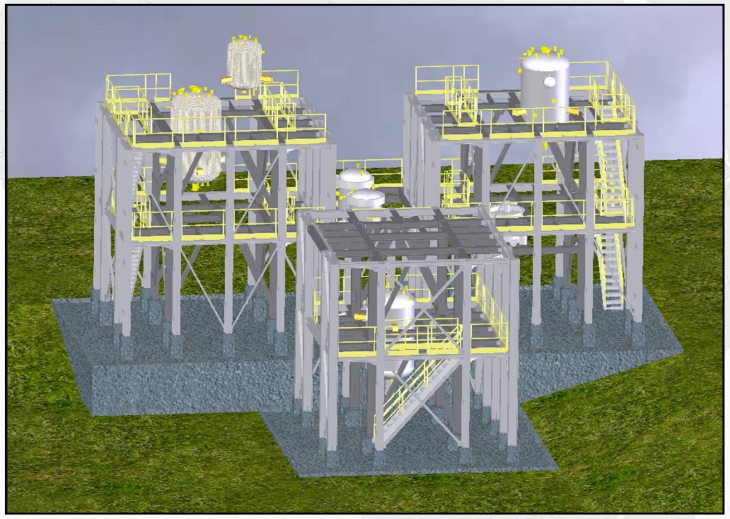
Mixer Control Panel

Hydraulic Pump Un

MRC Energetics Processing Module

Front View

Side View, Lower Rear



Structural Modeling of EPM

MRC Energetics Processing Module

Ammonia Storage Tanks

Ammonia Charging Hopper & Extraction Vessel Installed

MRC Energetics Processing Module

EPM Main Processing Area

MRC Energetics Processing Module

EPM “Yard” Support Equipment

MRC Hardware Decontamination Module

Copper cones prior to flashing furnace

Copper cones after flashing furnace

- Transportable Flashing Furnace decontaminates missile hardware components to 5X cleanliness
- Began operations at the ADMC in FEB 06 and to date processed:
  - 30,820 lbs of copper
  - 17,835 lbs of aluminum

AMRDEC MLRS Recycling

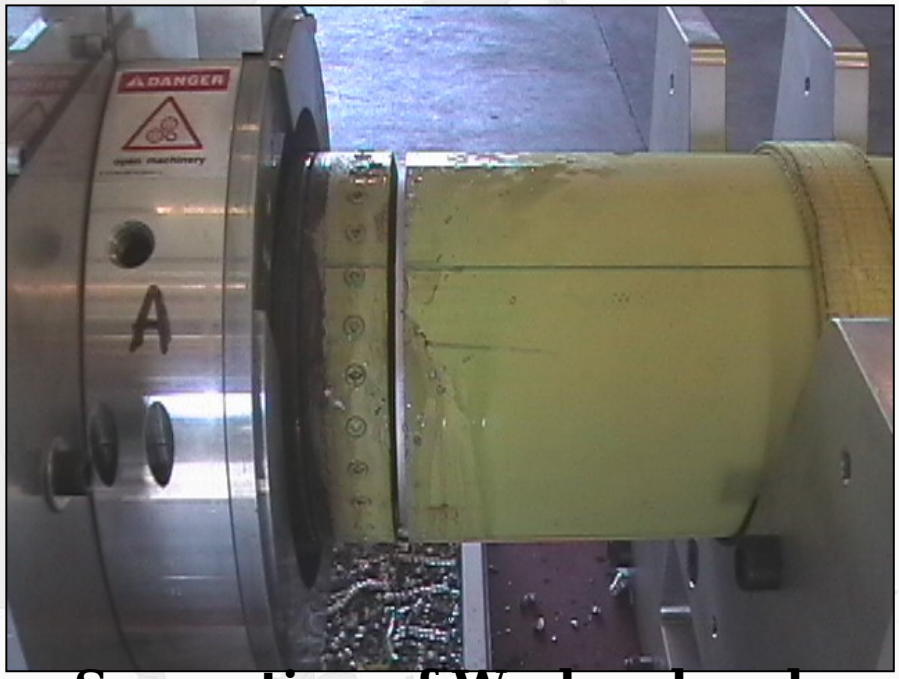
AMRDEC MLRS Recycling

Removal of MLRS Rocket from the Pod

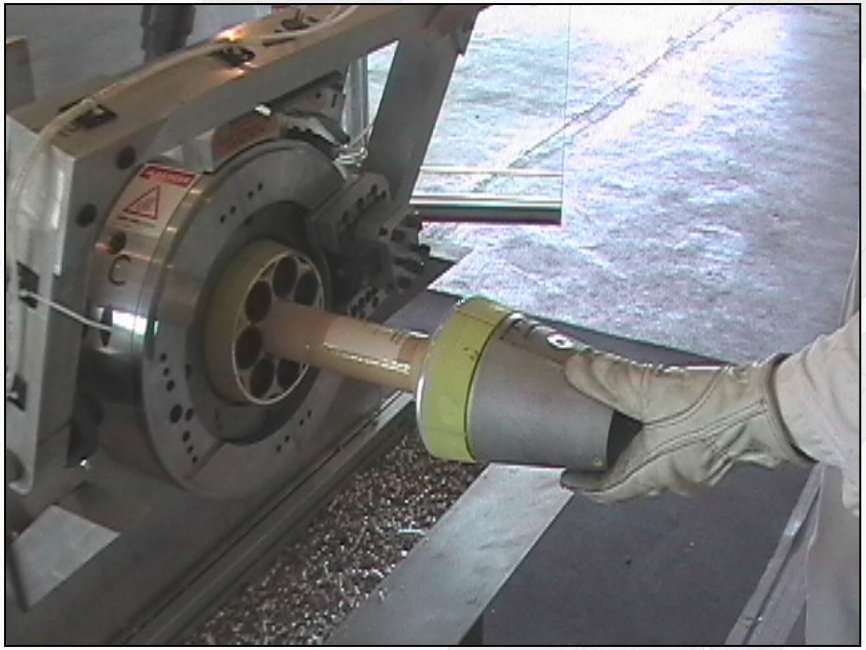
LRS Rocket on the Transport Cart

MLRS Warhead/Rocket Motor Separation Sta

AMRDEC MLRS Recycling

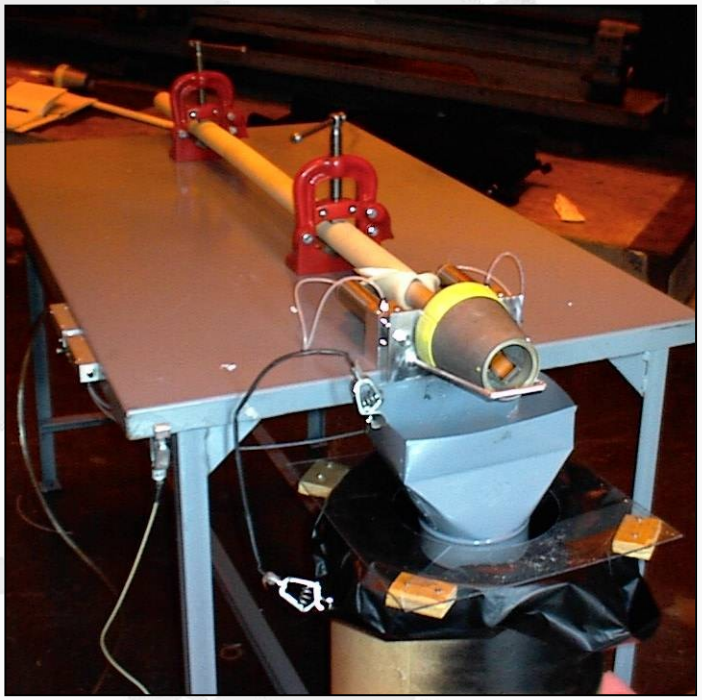


Separation of Warhead and Rocket motor after Cutting Operations

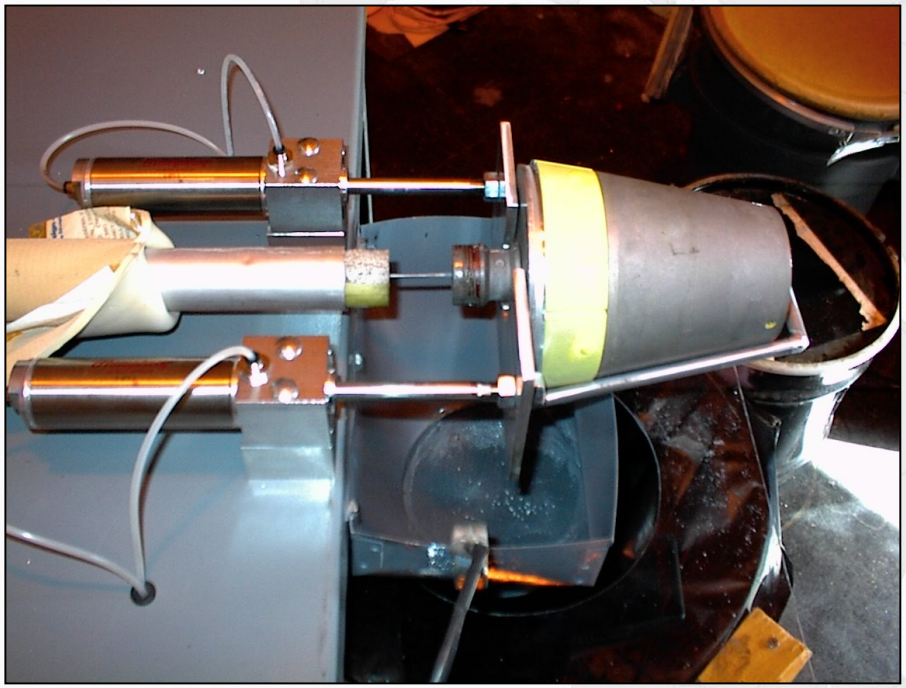


Removal of CCB after Cutting Operati

AMRDEC MLRS CCB Disassembly

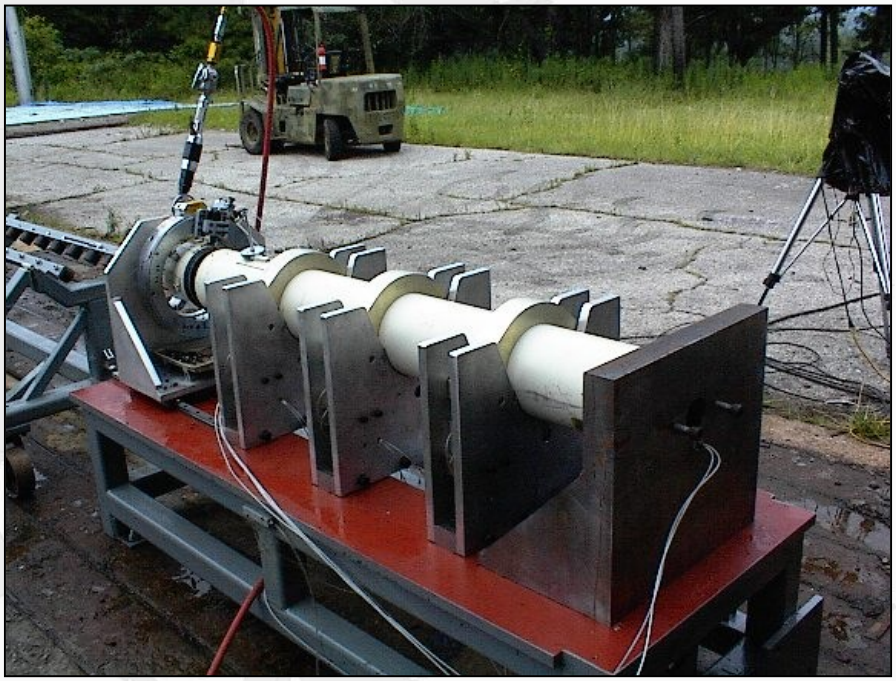


CCB Disassembly Station



CCB Forward End Plug/Bulkhead Remo

AMRDEC MLRS Nozzle Removal

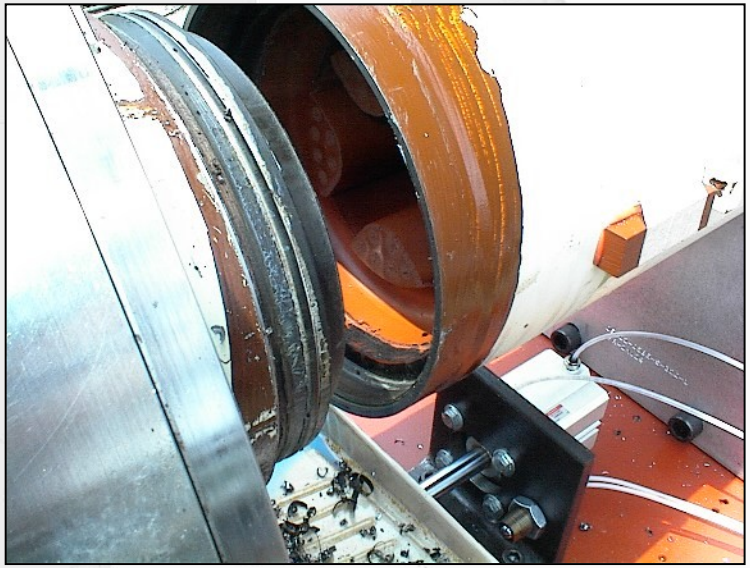


MLRS rocket motor secured in the Nozzle Removal Station

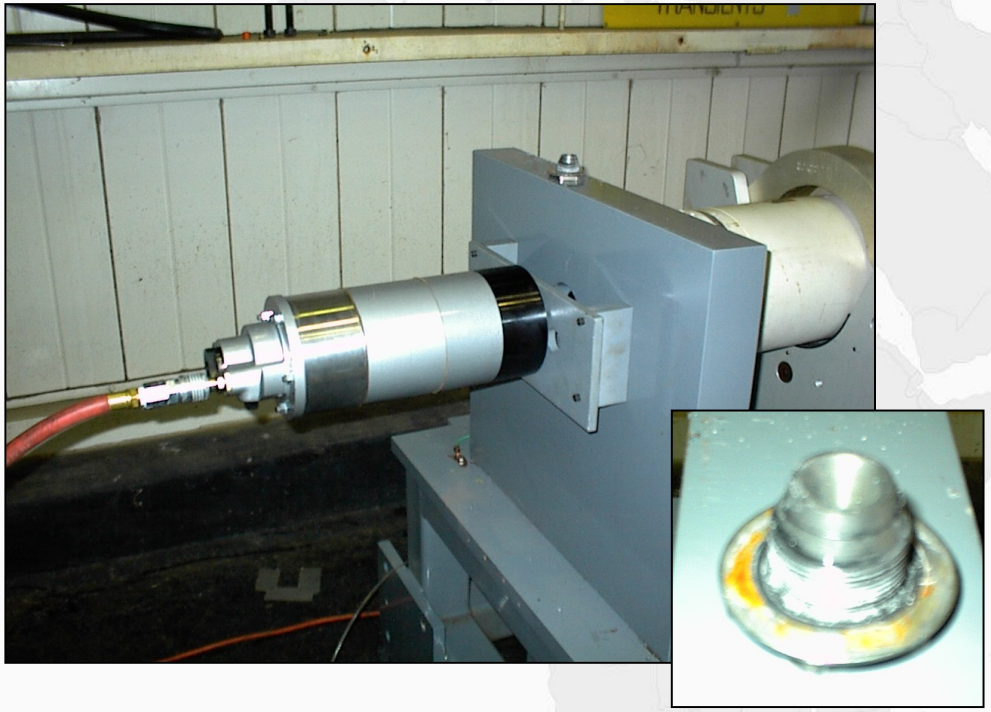
Thermal Image of Cut

- Removed nozzles from 78 M26 rockets to support Navy Crane/ATK Washout demonstrations

AMRDEC Nozzle Removal

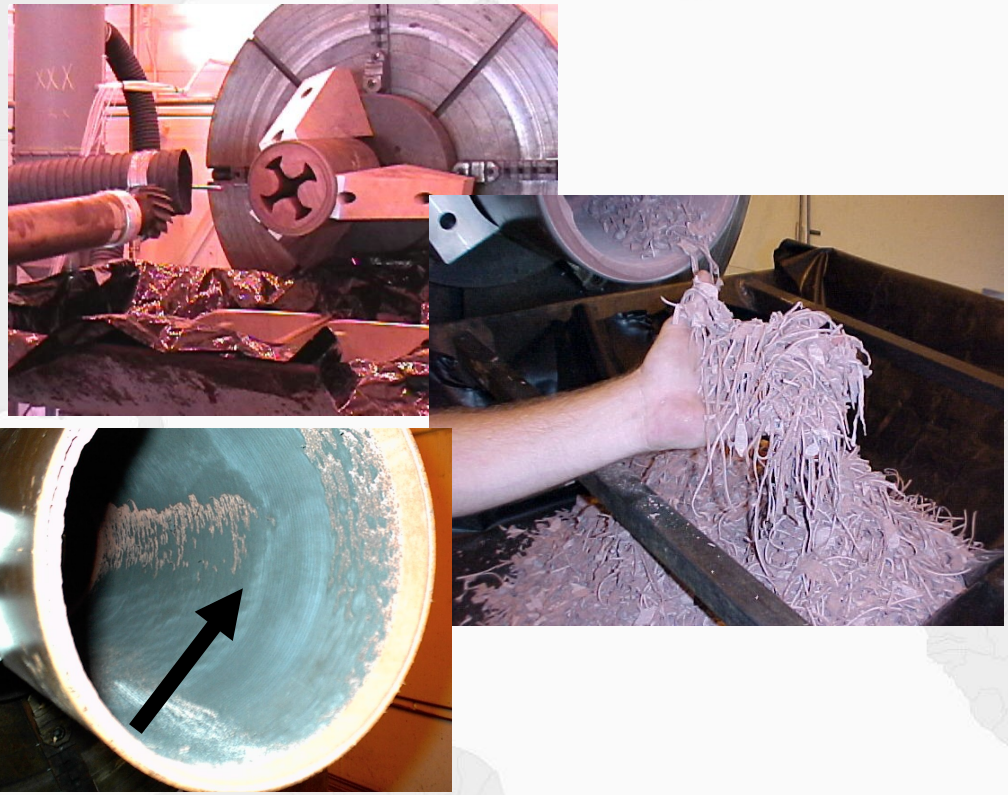


Nozzle extraction



Forward End Plug Removal Performed with Nozzle Removal Station

AMRDEC MLRS Propellant Removal



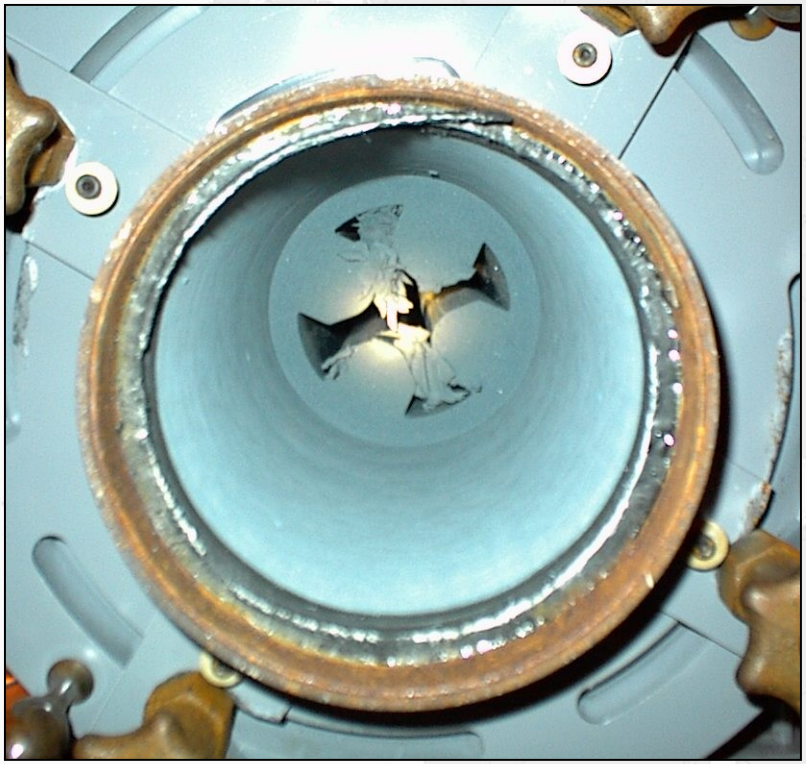
Propellant & liner removed

Installation of Prototype MLRS Milling Station

- Develop & demonstrate MLRS rocket motor propellant machining
- Total structural dimensions: base- 20’ X

AMRDEC MLRS Propellant Removal

Removal of Inert Propellant from a MLRS Rocket Motor

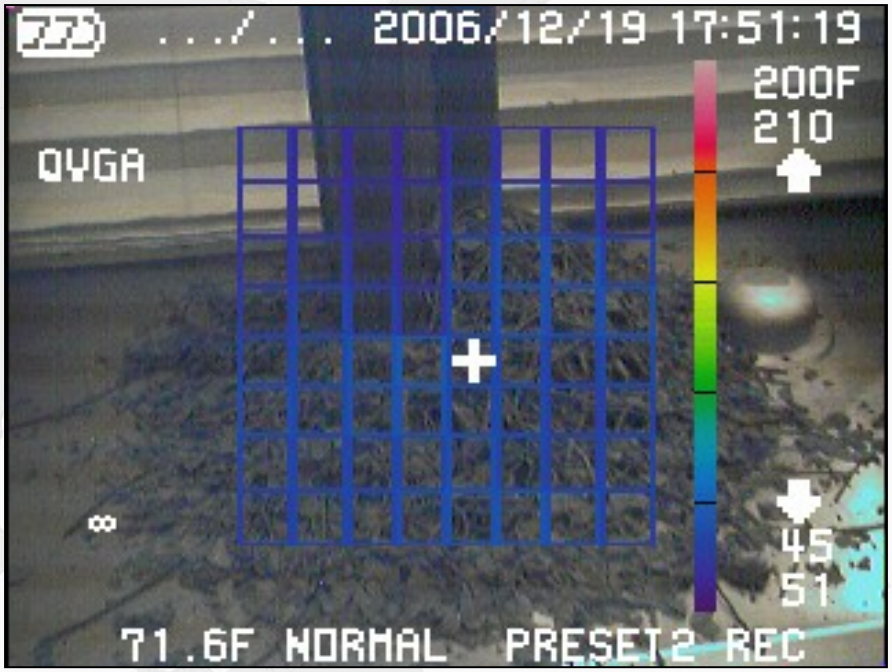


Inside MLRS Rocket Motor after Partial Inert Propellant Removal

AMRDEC MLRS Propellant Removal

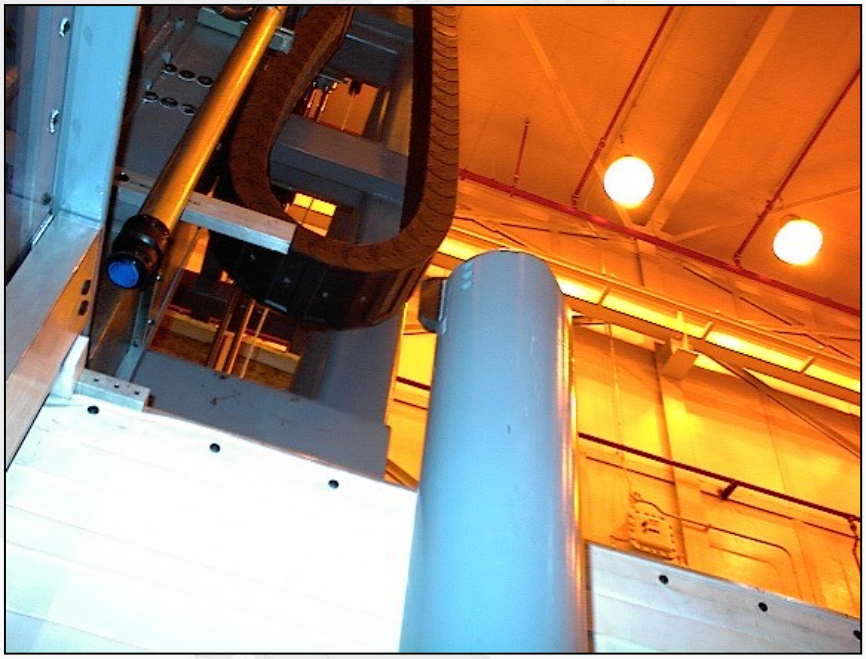
Inert Propellant Removed from MLRS Rocket Motor

AMRDEC MLRS Propellant Removal



- Increase of 10-20 F observed with propellant chips and m
- Temperature increase dependent on feed rate
- No increase in temperature observed on propellant in mo

AMRDEC MLRS Propellant Removal



Secondary Propellant Removal Tool

Inert Propellant & Liner Removed Using Secondary Propellant Removal Tool

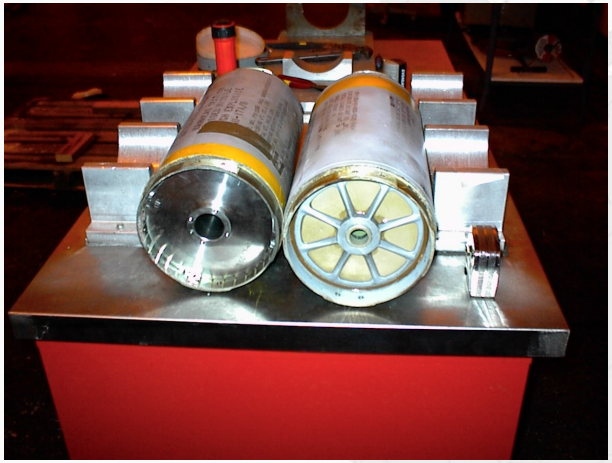
Propellant & Liner Removed from “live” MLRS Section Using Secondary Propellant Removal Tool

Missile Warhead Disassembly

OSM RDT&E

- Perform warhead R3 evaluations
- Demonstrate proto-type warhead disassembly fixtures
- Modify MRC energetics removal processes for warhead recy

Harm

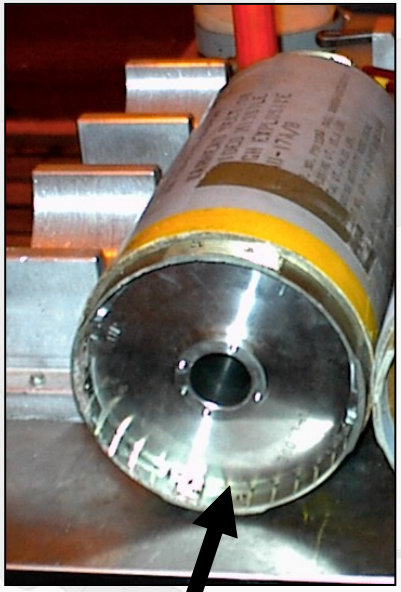


Sparrow

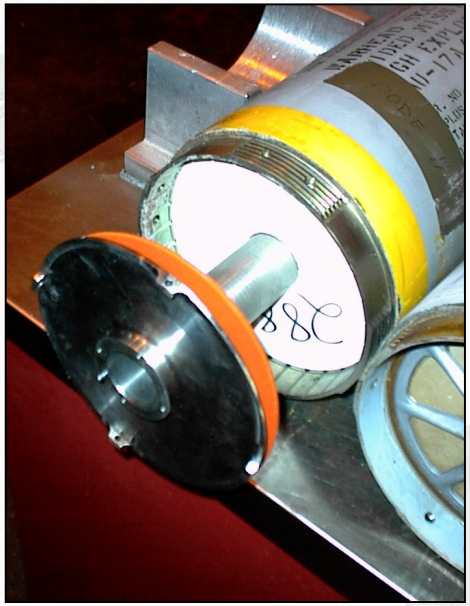
Shrike

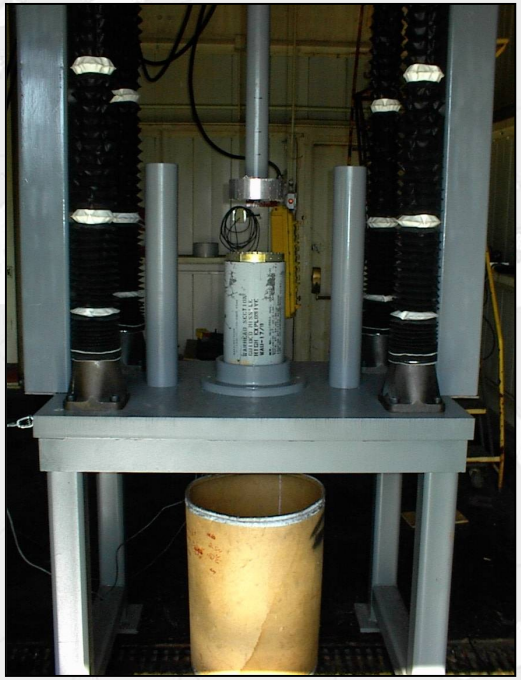
Phoenix

Sparrow 17 A/B Warhead Disassembly



Forward Closure Plate/Assembly





Remotely operated billet press-out machine

Recovered PBXN

Sparrow 10/B Warhead Disassembly

Aft Support Removal

Bulkhead Cutting and Removal

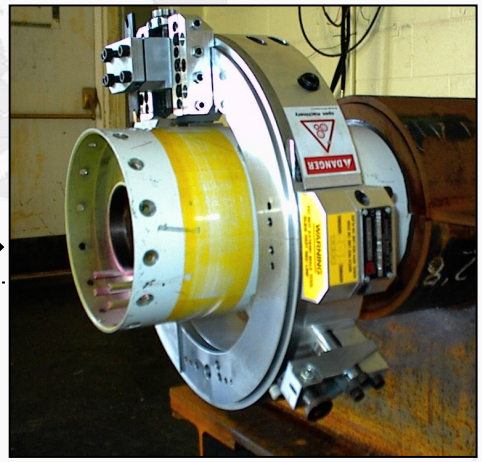
Imbedded Igniter Tube

Warhead in Press-out Machine

DATB billet and magnesium

Shrike Warhead Disassembly

Shrike Warhead



Bulkhead Weldment Removal

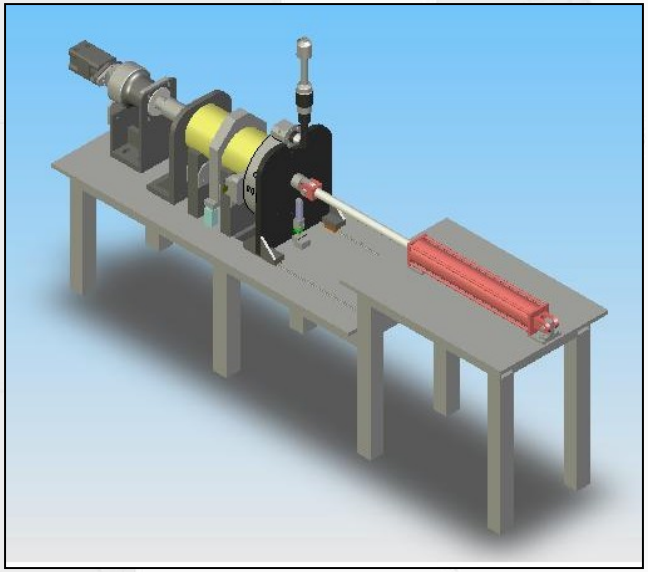
Wire Harness Tube Weldment Removal

Bulkhead and Igniter Well Removal

Warhead Billet Press Out

Recovered Billet and Hardware Components

Warhead Disassembly Machine

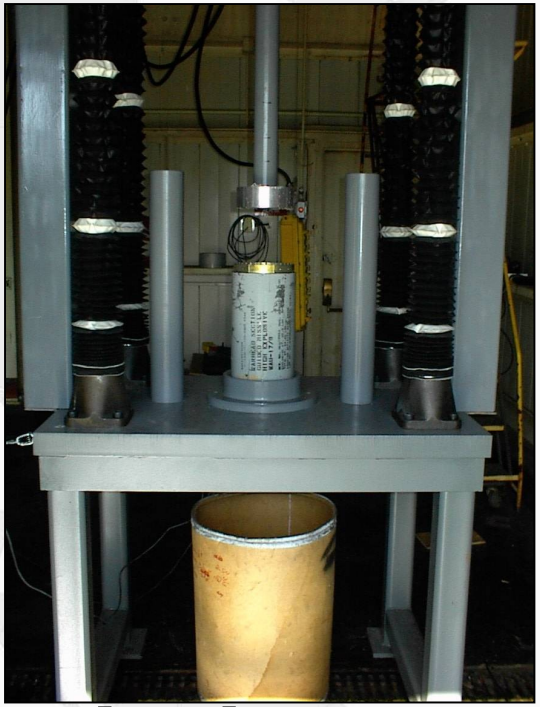


Warhead Disassembly Machine

Warhead Disassembly Machine Comp

- Machine will be used for Sparrow (10/B & 17A/B) and Shrike with minor tooling changes only
- Machine currently in fabrication and assembly
- Scheduled to be installed at the LEMC DEC 07

Warhead Press-Out Machine



Warhead Press-Out Machine

Tool Sets for Warhead Press-Out Machine

- Machine will be used for Sparrow (10/B & 17A/B) and Shrike with minor tooling changes only
- Machine has been tested with Sparrow 17A/B
- Scheduled to be installed at the LEMC in DEC 07

Sparrow 17 A/B Warhead Disassembly

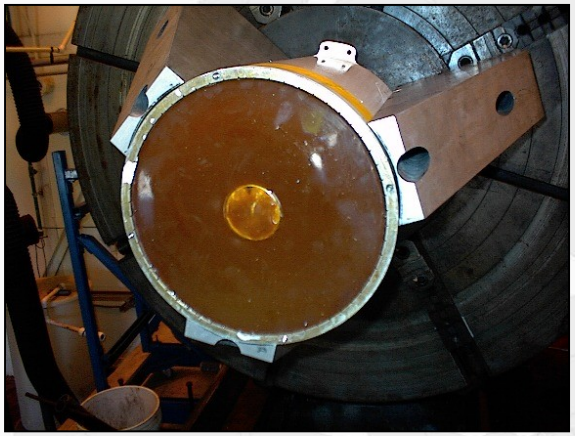
Temperature Test Data

Test #	Soak Temp (F)	Duration (hrs)	Ambient Temp (F)	Casing Temp (F)	Billet Surface Temp (F)	Igniter Tube Well Temp (F)	Force (psi)	Successful Press Out
1	-10	48	85	23	17	15	1500	Yes
2	-10	48	85	23	17	15	1500	Yes
3	Ambient	N/A	85	65	65	65	1500	No
4	Ambient	N/A	85	65	65	65	1500	No
5	10	48	83	35	23	21	1500	Yes
6	10	48	83	35	23	21	1500	Yes
7	20	24	85	37	45	27	1500	Yes
8	20	24	85	35	45	22	1500	Yes
9	10	72	86	71	67	60	1500	Yes
10	10	72	86	71	67	60	1500	Yes
11	10	16	85	23	17	15	1500	Yes
12	10	16	85	23	17	15	1500	Yes

Cool temperature cycling @ ≤ 20°F required for successfu

Phoenix Warhead Disassembly

Forward Cover Removal



Energetics Exposed

Dry Machining of Energetics

Recovered Chips

SUMMARY

- Missile recycling operations in Building 381 began early in 2003
  - ~ 45,000 TOW missiles processed to date
  - ~1,050,000 lbs. of scrap metal recycled to date

- >98% of missile components are recyclable into commercial and military reuse products
  - MRC is source of supply for missile launch tubes and end closure components
  - Investigating reuse/recycle of several other components

- MRC technology being developed and evaluated for MLRS
  - Production scale equipment fabricated and tested at Redstone Arsenal for MLRS

- MRC technology being developed and evaluated for OSM missile warheads stored at the LEMC